13.0 RECOMMENDATIONS

The Monitoring and Reporting Program (MRP) under the current NPDES Permit consists of three monitoring elements with defined objectives and specific sampling and analysis requirements. The three monitoring elements that are being conducted as part of the 2001-2005 monitoring program consist of Core Monitoring, Regional Monitoring, and Special Studies. The 1996 Permit included mass emission stations, targeted land use, and critical industry monitoring. The primary objectives of the overall MRP as stated in the 2001 NPDES Permit were summarized in the previous section with a summary of the current findings and conclusions that address these objectives. Recommendations to better address these program objectives were highlighted in Table 12-1. These highlighted recommendations are presented in Table 13-1 with the corresponding MRP objectives. This section presents further discussion of these recommendations and additional ones that address specific components of the three monitoring elements. The following recommendations include monitoring, research, and studies that should be considered or undertaken to better address the MRP objectives, advance the understanding of stormwater quality science and support TMDL programs. Because of their scope, such studies should be undertaken by various entities, such as the Regional Water Quality Board, NPDES permittees, or by collaborative efforts between private and public organizations. The recommendations presented consider the effective use of available resources by balancing costs through scientifically based recommended tradeoff options.

Table 13-1. MRP Objectives and Conclusions.

MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Recommendations Based on Current Findings/Conclusions
1) Assessing compliance with the NPDES Permit granted to Los Angeles County	The Permit includes the monitoring program activities that are required by LACDPW.	• Continue programs with modifications as recommended under the following objectives.
2) Measuring and improving the effectiveness of the SQMPs	The SQMP contains programs in the areas of 1) Public Information; 2) Industrial/Commercial Control; 3)Development Planning; 4)Development Construction; 5)Public Agency Activities; 6) Illicit Connection/ Illicit Discharge Elimination Program. Emphasis of the SQMP is pollution prevention through education, inspection, public outreach, planning, and implementation of BMPs.	• In order to more efficiently meet this objective, it is recommended to re-design the monitoring program to reduce the frequency of base of watershed (MES) monitoring since no significant short-term trends are indicated for the primary COCs, and use resources on more focused sampling up into the watershed.

Table 13-1. MRP Objectives and Conclusions (continued).

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MRP Objective	Corresponding Monitoring Program/Activities that Addresses Objective in the 2001 Permit	Summary of Recommendations Based on Current Findings/Conclusions
3) Assessing the chemical, physical, and biological impacts from urban runoff on receiving waters	The Core Monitoring program as required under the MRP includes water quality monitoring of the mass loading stations and tributaries for wet and dry weather. It also includes water quality toxicity monitoring at the mass emissions stations. Bioassessments have also been conducted as part of the monitoring program to study the impact on the ecology of the receiving waters. Estuary sampling that includes toxicity analysis of sediments was conducted to assess the impacts to the estuary environment from the watersheds. The results from this program provide the basis for assessing the chemical, physical and biological impacts to the receiving waters.	• In order to better address this program objective, it is recommended to continue the dry weather program at the MES.
4) Characterization of stormwater discharges	The Core Monitoring program as required under the MRP includes characterization of the stormwater at the mass loading and tributary stations for wet and dry weather. It also includes water quality toxicity monitoring at the mass emission stations.	• Further sampling of storm drains is needed to better assess stormwater contributions to loadings and exceedances of WQO.
5) Identifying sources of pollutants	The tributary monitoring program provides initial data to better define potential sources of higher constituent loading within the watersheds sampled. Tributary sampling has been conducted on Los Angeles River and Ballona Creek (Previous studies have only hypothesized about the potential sources of pollutants in the tributaries).	• Continued tributary sampling should be conducted on designated watersheds to first identify the sub-watersheds that are contributing the greatest loadings and contributions to exceedances of the WQO. The tributary sampling should be coordinated with any required TMDL studies and compliance monitoring to best use available resources. A trade-off of reduction of the frequency of sampling at the MES, should be made with increased tributary monitoring.
6) Assessing the overall health and evaluating long-term trends in receiving water quality	The Core Monitoring program consisting of water quality monitoring at the mass emission stations at each of the six watersheds and tributary monitoring provide for an assessment of overall health and long-term trends in the receiving water quality. Additional intra-regional and special studies including the bioassessment program and the estuary sampling also provide the basis for an overall assessment.	• Wet weather sampling at the MES does not indicate statistically significant short term trends at the MES. Until significant management actions and subsequent reductions in the loadings of the COC are implemented, the frequency of the wet weather MES sampling should be reduced. These reductions provide a tradeoff of resources to allow for continued dry weather monitoring at the MES (only 3-4 years of dry weather monitoring has been conducted), and expansion of monitoring up in the watershed on a sub-watershed basis. This approach will allow for more effective use of resources and determination of trends in specific sub-watersheds and drainage areas that have been identified as contributing the greatest loads and that have been identified for implementation of management actions and BMP to reduce the loadings. This focused sampling and trend analysis will allow for assessment of the effectiveness of the SQMP within these identified higher contributing sub-watersheds.

The overall goal of the MRP is to provide results that are to be used to refine the SQMP for the reduction of pollutant loadings and the protection and enhancement of the beneficial uses of the receiving waters in Los Angeles County. As presented in Section 12, the results of the monitoring program that have been conducted in the Ballona WMA provide a model for the

other watershed programs in further meeting this overall goal of the MRP. The Ballona "Model" consists of an already extensive data base of wet weather monitoring at the MES that provides a basis for assessment of overall water quality in the watershed, and determination of trends in the concentrations and loadings from the drainage area monitored by the MES. A similar data set also exists for the Los Angeles River for which tributary monitoring has also been conducted. For both WMA in which tributary monitoring has been conducted, results have identified drainage areas that contribute a greater magnitude of the exceedances of WQO and overall loadings. Based on the analysis of trends (presented in this section), the wet weather sampling frequency at the MES can be reduced and still meet the objectives of assessment of water quality with regard to meeting the WQO.

The three years of dry weather data at the MES has provided additional water quality data for overall trend analysis and comparison to WQO for the entire watershed. Continued dry weather sampling at the MES is recommended to provide sufficient data to evaluate trends specifically for dry weather and to better quantify total loads from urban runoff during low flow periods. Dry and wet weather toxicity testing at the MES provides further data to assess the impacts to the receiving waters and comparisons to the chemical data for the MES. Bioassessment stations should also be co-located at the MES and tributary chemistry sampling locations to allow for better collaboration of data on assessing impacts to receiving waters.

As discussed in Section 7 and 12, the Ballona model includes tributary monitoring that has provided water quality and loading information on a sub-watershed level. These results have allowed for identification of sub-watersheds that are contributing the larger percentages of pollutant loadings. These data are key to identifying where the primary sources are located and determination of priority sub-watersheds and/or drainage areas that should be the focus of management actions and BMPs to reduce loading to the receiving waters. Upstream tributary monitoring should be coordinated with any required TMDL compliance monitoring to use available resources effectively.

From this model, recommendations can be developed to enhance the overall MRP to best meet the overall and program specific objectives listed above. These program level recommendations include:

- In order to better meet the objectives of the Core Monitoring Program with regard to source identification and measurement of the effectiveness of the implementation of SQMP, greater monitoring should be conducted up into the watershed through continuation of the tributary monitoring program. These programs should be coordinated with any required TMDL compliance monitoring to use available resources effectively.

- The frequency of the sampling at the MES can be reduced and still meet the objectives of the monitoring program allowing for more efficient use of resources. Overall trends can be determined through reduced frequency at the MES based on long-term trend analysis. These long-term trend analyses are discussed in more detail under the Core Monitoring recommendations. The reduction in MES monitoring can thereby be used as a tradeoff for expansion of the monitoring further up the watershed and better address the objectives of the monitoring program as identified in the recommendations above.

These and other recommendations under the three monitoring elements are discussed below with further analysis of the basis of the recommendation. Finally, an estimated budget summary is presented based on the recommendations for each of the monitoring programs in the permit.

13.1 Core Monitoring Element Recommendations

The current core monitoring element includes Mass Emission Monitoring, Water Column Toxicity Monitoring, Tributary Monitoring, Shoreline Monitoring and Trash Monitoring. Based on the results and the subsequent conclusions from the Core Monitoring Program over the last 10 years, improvements/modifications to this program are presented below for each element of the program in order to better address the objectives of the MRP.

Continuation and Expansion of Tributary Sampling Program

The Core Monitoring Element has been successful in addressing the objectives regarding stormwater characterization, long-term trends and compliance with the permit on a watershed area basis. The results indicate that continued impacts to receiving waters by urban runoff are resulting in exceedances of the water quality objectives for bacteria indicators, numerous metals and several other water chemistry constituents in all the watersheds. For these constituents that exceed the WQO, there is generally no *statistically significant* trend in concentrations based on the combined wet and dry weather data. The data collected to date is primarily focused at the Mass Emission Site that provides an overall characterization of the portion of the watershed that is monitored, but does not provide data on the pollutant sources and long-term trends and water quality improvements of the SQMP on a sub-watershed level where specific source control and structural BMPs may have been implemented. These objectives are being addressed to a greater extent through the Tributary Monitoring Program, which has been conducted on the Los Angeles River WMA in 2002 to 2004, and in the Ballona Creek in 2004-2005. The Tributary Monitoring Program is partially successful at addressing the identification of sources and the possible measurement of specific improvements in water quality from the implementation of BMPs.

In order to better address all the objectives of the Core Monitoring Element, the core element could expand the tributary monitoring program, where a trade-off of other components can allow re-allocation of available resources. The benefit of this approach has been demonstrated through the results of the "model" monitoring program discuss above for Ballona Creek and further discussed in Sections 7 and 12. The results of the MES and tributary studies conducted in the Ballona Creek Watershed provide the basis for prioritization of management actions and BMP implementation in order to effectively use available resources to result in the greatest amount of load reductions to the receiving waters.

The actual scope and time-line for the recommended modification to the Core Monitoring Element to include a greater number of sampling points up into the watersheds under the tributary program must depend on available resources and tradeoff with other components of the Monitoring Element. An estimated annual budget and suggested schedule of implementation is presented in Sub-Section 13.4.

Reduction in the Frequency of Wet Weather Monitoring at the MES

Wet weather data has been collected at the MES for all the watersheds since 1995 with the exception of Santa Clara River, which began in 2002. Therefore, for nearly all the monitored watersheds, 10 years of wet weather data has been collected. Primary COCs have been identified and impacts to the receiving waters assessed. For the identified COCs that consistently exceed WQO, there was no *statistically significant* trend in the concentrations of bacteriological indicators and total copper, lead and zinc. In the absence of significant reduction of these constituents throughout the watershed, water quality conditions in the short-term will not vary significantly. It is important that the monitoring program detect long-term trends as reductions in loadings are achieved. As discussed below, modification of the wet weather program at the MES can still achieve this goal. Furthermore, as discussed previously, the objectives of the MRP can be better addressed through the expansion of the tributary monitoring program.

A major consideration of any redesign of a monitoring program is an evaluation of the impacts that the changes may have on the analysis and interpretation of the results. The recommendation to change the quantity or frequency of sampling therefore necessitates a thorough look at the impacts on following established trends in the data and detecting the development of changes or trends in the data. To determine the impacts of reducing the quantity and/or frequency of sampling the MES, an analysis was performed to simulate future data and determine the timeframe sampling would need to be performed to ascertain with 95 percent confidence that concentrations were below the pertinent water quality objective.

The analysis uses $\log_{10}$ transformed data to determine the equation of the regression line drawn through the existing data. Log transformation is commonly used to normalize data when concentrations are of different orders of magnitude. The regression equation is used to compute the predicted mean value in future years and the standard deviation from the regression analysis, data are generated for each future year with a mean equal to the predicted mean and are randomly distributed within the bounds of the standard deviation. Using these simulated data with the existing data, the regression is rerun and the point in time when the upper 95% confidence bound of the regression crosses below the water quality objective is determined. Because this is just one random simulation that may be anomalous, this process is repeated with 100 sets of randomly simulated data based on the original equation. The entire set of 100 regressions is then evaluated to determine when the upper confidence bound is below the water quality objective 95 out of 100 times. This is the number of years of sampling that must occur to be confident that the concentration meets the objective. This whole process is performed for sampling a) three storm events every year into the future, b) three sampling events in alternate years, c) two storm events every year, and d) two storm events in alternate years.

The results of this statistical analysis are presented on Figures 13-1, 13-2, and 13-3 for the Los Angeles River, San Gabriel River and Malibu Creek watersheds, respectively. Presented on these figures is a comparison of the time-lines that would be anticipated to reach the WQO for primary COC for different sampling frequencies. For the last three years, wet weather monitoring at the MES was conducted for 3-4 storm events. Figures 13-1 to 13-3 present the time-line when the regression line (blue line) and the 95% confidence level line (green line) intersect the WQO concentration for 3 events per year, 3 events per year using alternate years, 2 events per year, and 2 events per year for alternate years. The vertical lines represent when the WQO is met. The regression line and 95% confidence line were generated assuming no

significant reduction in concentrations. **These conservative assumptions were used to verify that recommended reductions in sampling frequency will not significantly impact the time-line of required monitoring until the concentrations are below the WQO. This is a conservative assumption because if the trend was significant the time-frame to reach the WQO would be shorter and so would the differences between the current and proposed program to identify this point.**

As shown on Figure 13-1 for the Los Angeles River, the timeframe to reach when the concentration of total copper is at the WQO (intersection of the blue regression line with the red WQO line) is estimated at approximately 35 years. If the frequency of the MES sampling is modified to 3 events every other year (alternate years), the timeframe to reach the WQO with the assumed rates of reductions as discussed will still be approximately 35 years. At the frequency of 2 events per year, the timeframe is approximately 38-40 years. **Therefore a lower frequency than is currently implanted for the MES monitoring will still be effective in assessing water quality of receiving waters from the entire monitored watershed and detecting the reduction of the COC down to the WQO within a similar timeframe due to the anticipated long period of time (30-40 years for the given example) to reach this goal.**

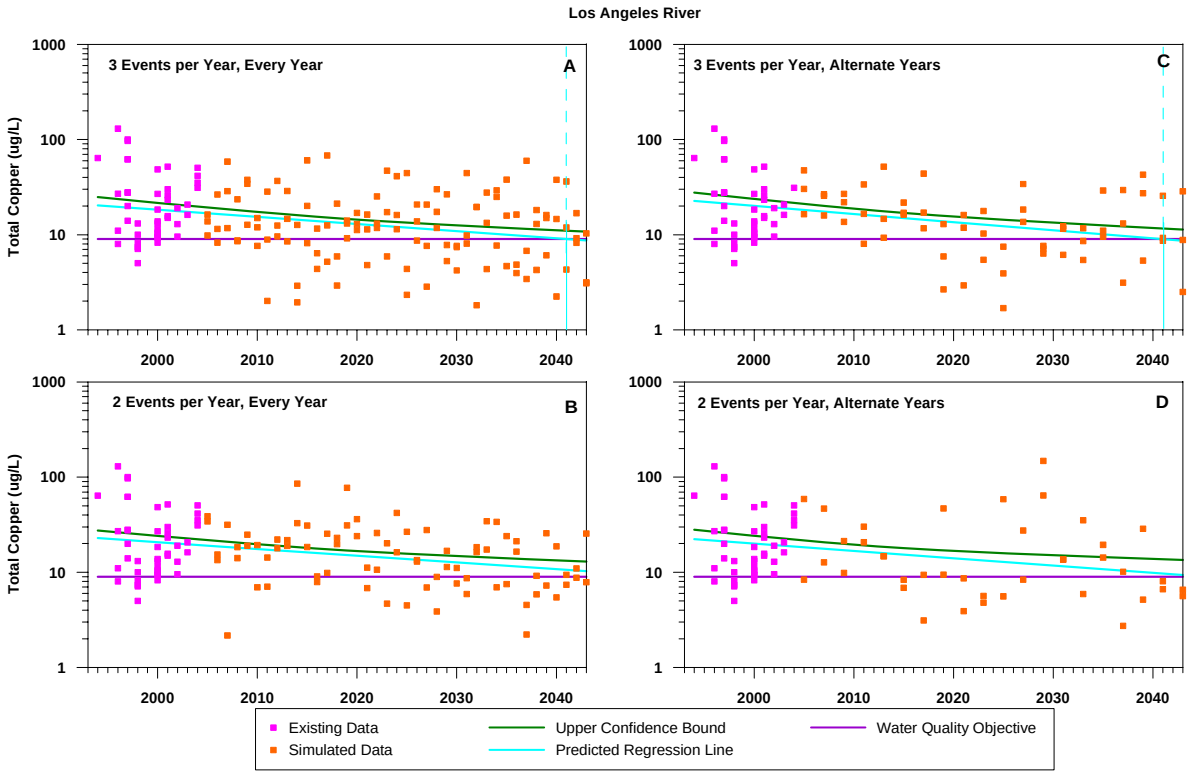

Figure 13-1. Regression analysis for total copper at Los Angeles River with simulated data.

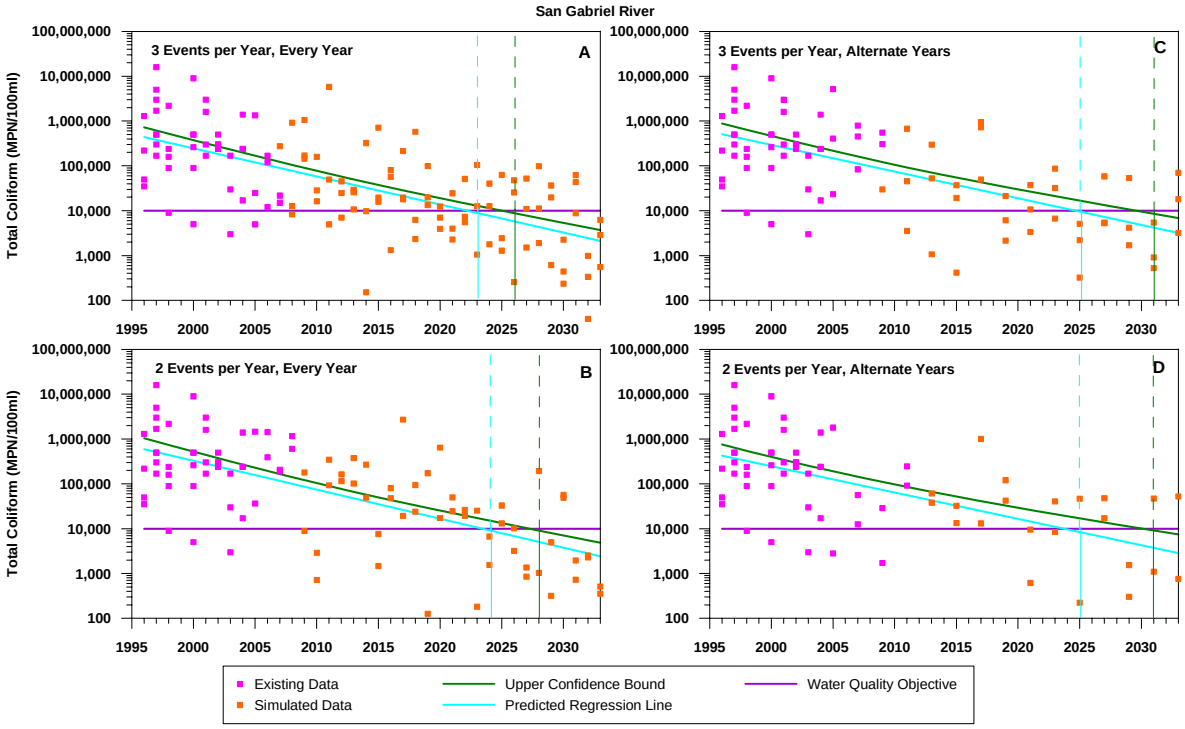

Figure 13-2. Regression analysis for total coliforms at San Gabriel River with simulated data.

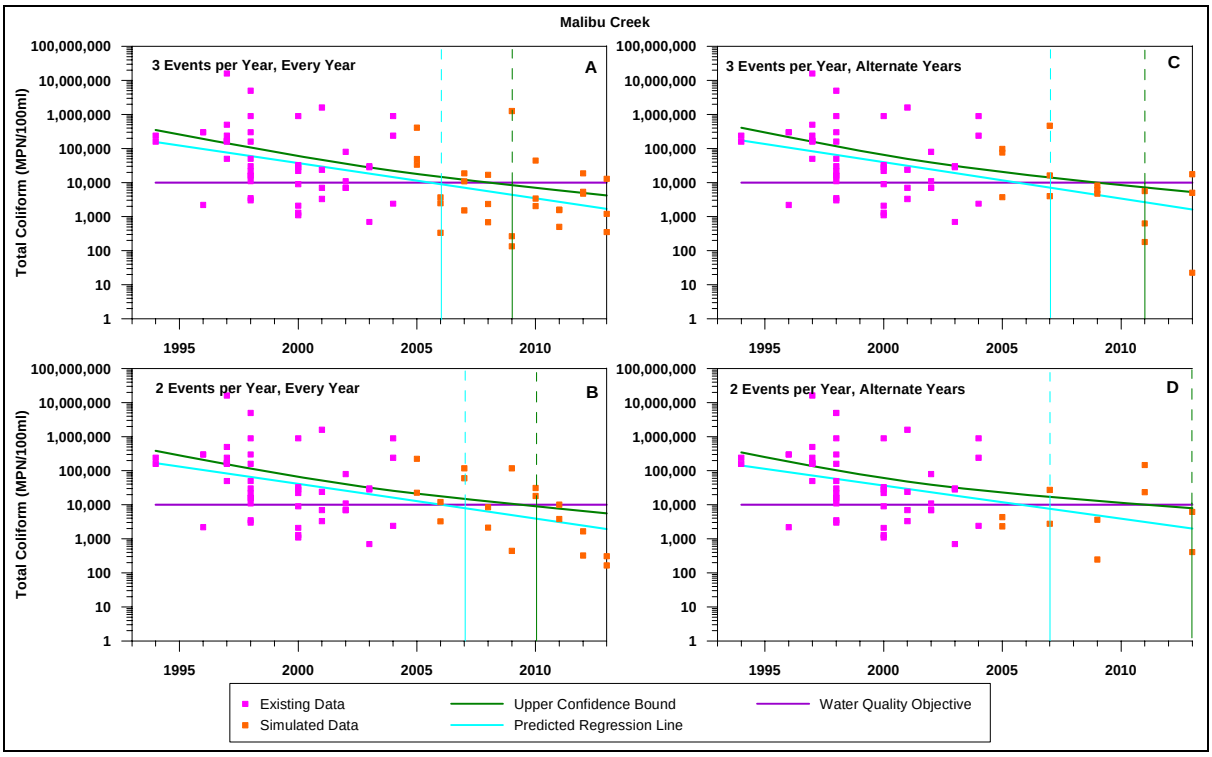

Figure 13-3. Regression analysis for total coliforms at Malibu Creek with simulated data.

Similar conclusions can be derived from Figures 13-2 and 13-3 that present the timeframes to reach the WQO for total coliform at the MES for San Gabriel River and Malibu Creek, respectively. Although the overall timeframes are less than for the example presented in Figure 13-1 (approximately 20-23 years for San Gabriel River and 3-6 years for Malibu Creek), the differences in timeframes to reach the WQO between the 3 and 2 events per year and 3 events and 3 events on alternate years is not significant. Reductions in frequency from 3 to 2 events per year; or, from 3 events annual to alternative years, are recommended for the wet weather sampling at the MES.

Similar analyses have been conducted using stormwater data from San Diego County to evaluate the recommended redesign of the stormwater monitoring program for this region. These results are provided in Appendix I. These analyses include evaluation of additional potential long-term trends such as an increasing trend and no significant long-term trend. The conclusions of these additional scenarios were that the difference in the timeframe to determine and assess these trends was not significant between the current annual monitoring and the recommended reduced frequency for wet weather monitoring at the MES. These analyses provide further support to this recommendation.

Frequencies for dry weather sampling at the MES should be considered in the future following collection of sufficient data to assess specific contributions from urban runoff during dry weather and specific trends in the dry weather results.

Modification of the Analytical Program for Mass Emission Monitoring

It had been recommended in the 2000 Integrated Receiving Water Impact Report to remove from the analytical suite for the associated mass emission monitoring station those constituents that have been detected in less than 25% of ten consecutive sampling events; identified COCs would continue to be monitored. This recommendation remains applicable, particularly for those constituents groups that have not been frequently detected in the last five years of monitoring, and have no detections above the applicable WQO. A review of the analytical results for the past five years indicates that no to very low frequency of detections were reported under the following constituent groups:

- Semi-volatile organic compounds (SVOCs)
- Pesticides as listed for EPA Method 625
- Polychlorinated Biphenyls (PCBs)
- Herbicides (glyphosate, 2,4-D, 2,4,5-TP-Silvex)

With the already extensive data set (more than 30 sampling events) demonstrating that these constituents are not present at detectable concentrations or at very low frequencies in stormwater, it is therefore recommended that the constituent within these groups be removed from the analytical suite for the mass emission stations. The exceptions are PCBs and the pesticide DDT, which are currently analyzed using methods that result in a practical quantitation limit (PQL) greater than the WQO. For these constituents, the recommendation is to reduce the PQL where possible as discussed under the next recommendation.

SVOCs are not highly mobile in surface water and tend to remain adsorbed to sediments. If appropriate, these constituents should be included in the analysis of sediments. A number of SVOCs that include PAHs were detected in MES stormwater samples. All these detections were reported at a frequency of less than 2% out of over 100 samples collected at the MES, with the exception of Bis (2-ethyhexl) phthalate (6.4%) and Diethyl phthalate (6%). These compounds are likely associated with laboratory and sample handling as a constituent from plastic gloves and other plastic ware. None of the PAHs were detected at concentrations above the WQO. PCBs were not detected in any of the stormwater samples at the MES or tributary locations.

Although it is recommended to remove the legacy herbicides listed under EPA Method 625 based on no detections, the legacy herbicides may be included on the analyte list for tributary sampling and special studies based on a review of existing data and information/evidence of potential sources of these constituents within the sub-watershed being monitored.

Modification of Analytical Methods for Core Monitoring Program

As discussed in Sections 4 through 9, mercury and thallium were identified in the analytical summary tables of the mean annual concentrations for each watershed as constituents that exceeded the WQO. These metals were reported as non-detected, but the exceedance was based on half the Practical Quantitation Limit (PQL) being greater than the WQO. The WQO for mercury is 0.16 µg/L compared to the PQL of 1.0 µg/L reported by the analytical laboratory using EPA Method 200.8. The PQL for thallium is 5 µg/L compared to the WQO of 2 µg/L. In order to meet the data quality objective of attaining the lowest practical analytical reporting limit (PQL) to confirm that the constituent is not present at a concentration that exceeds the WQO, modification to the analytical methods is recommended where possible. Similarly, it is recommended that lowest practical PQL be achieved for total PCBs and DDT, which also were reported as non-detects, but the PQL exceeds the WQO. Table 13-2 presents the lowest practical reporting limits (RL) and method detection limits (MDL) that can be achieved according to a commercial laboratory that specializes in stormwater analysis.

Table 13-2. Summary of Lowest Practical Method Detection Limits and Reporting Limits for Mercury, Thallium, PCBs and DDTs.

Constituent	Method	Units	RL	MDL	WQO
Mercury	EPA 1631	µg/L	.0001	0.00005	0.16
Thallium	EPA 200.8	µg/L	0.5	0.1	2.0
PCB	EPA 625	µg/L	0.005	0.001	0.03
DDT	EPA 625	µg/L	0.005	0.001	0.001

Modification of Sampling Program for TSS

TSS sampling and analysis is part of the Core Monitoring Element. The purpose of the TSS sampling was to investigate possible correlations between TSS and COCs that include metals.

As discussed in Section 10, trends were statistically indicated for the Santa Clara River Watershed for total chromium, iron, lead and arsenic. A trend is also indicated for this watershed for dissolved copper and boron. The greatest number of correlations was identified

for the Santa Clara River Watershed, with few trends identified for other watersheds. The Santa Clara River Watershed is the least urbanized of the watersheds in the County. These results may indicate that correlations between TSS and metal concentrations are evident in the Santa Clara River Watershed possibly due to less diverse sources of metals within the watershed and a better correlation between sediment load and total metal concentrations in stormwater. However, correlations between TSS and metals in the other more urbanized watersheds were not statistically identified.

The value of continued TSS correlation monitoring throughout all the watersheds is suspect based on the results reported to date. The application of TSS results to establish correlations with other constituents does not appear to be the best use of available resources given the results. The methods used for TSS sampling and analysis may not be appropriate to fully capture the contribution of sediment loads to the measured water quality at the MES and to the receiving estuaries. TSS is collected within the water column with the water quality samples and is analyzed using current methods that do not capture the full sediment load or characterize the grain size and characteristics of the sediment load. For urbanized watersheds, sediment and inorganic and organic particles from streets and parking areas can vary greatly in size and dimension.

It is therefore recommended that the current TSS correlation study should be discontinued and the current state of the art for measuring sediment loads should be investigated by the Stormwater Monitoring Coalition, who should make recommendations on the sampling and analytical methods. Current research and published data on the success of different techniques should be assessed in developing these recommendations. For example, one method for analysis that has been standardized for better characterization of sediment loads is ASTM D3977-97 – Determining Sediment Concentrations in Water Samples. This test method allows for determination of sediment concentrations for various sediment types, which the current methods do not.

13.2 Regional Monitoring Element

Based on the results and conclusions presented in this Report the following recommendations are made for the Regional Monitoring Element:

Bioassessment Recommendations

- Continue the Bioassessment Monitoring Program at 20 sites throughout the county to assess biological conditions and monitor long term trends of urban runoff impacts
- Replace sites that are typically dry in the fall with sites more likely to have water flow
- Focus the bioassessment surveys to determine which tributaries may be of greater concern
- Change the sampling protocol to the CSBP 2003 version, allowing for a more cost effective sampling regime that will yield comparable results
- Co-locate bioassessment stations with MES and tributary samples, where feasible, to allow for more effective assessment of the data to meet the MRP objectives of assessing chemical, physical and biological impacts from urban runoff on receiving waters.

Bight Sampling

- Continue to support the Bight program where there is a research component strongly associated with the impacts due to stormwater.

13.3 Special Studies Program

Based on the results of the Monitoring Program as reported in this Report, it is recommended that Special Studies should be considered for identifying sources of pollutants in urban runoff and receiving waters.

13.4 Estimated Budget Summary

The current Monitoring Program Costs for each of the major program elements are summarized in Table 13-3.

Table 13-3. Total Monitoring Program Costs.

Monitoring Program	Total
Core Monitoring*	1,664,000
Shoreline Monitoring	City of Los Angeles[1]
Trash Monitoring	846,000
Bight '03 Estuaries Monitoring	608,000
Bioassessment	235,000
New Development Impacts Study in the Santa Clara Watershed	150,000
Peak Discharge Impact Study	292,000
BMP Effectiveness Study	666,000
Total Cost	**4,461,000**

* Core monitoring includes mass emissions, water column toxicity and tributary monitoring.
1 Refer to report prepared by the City of Los Angeles for expense or cost estimate.

The total amount of effort to date for the Monitoring Program under the 2001 Permit is approximately $4.5 million.

Based on the recommendations presented in this Section, the following are estimated cost modifications to the annual Monitoring Program budget:

- Reduction of the Wet Weather Monitoring at the MES for each of the WMA from 3-4 events to 2 events per year.

- Modification of the Core Monitoring Program analytical list through the elimination of SVOCs, pesticides (except DDT) and herbicides.

- Continuation and Expansion of the Tributary Program.
- Modification of analytical methods to achieve lower PQL for mercury, thallium, PCBs and DDT and sediment concentrations for MES and tributary sampling.

Table 13-4 provides an estimated projected annual budget for the Monitoring Program for the next five year permit cycle based on the recommendations presented in this section. The implementation of any future special studies will be scheduled based on the maximum annual budget of $400,000, and defined priorities.

Table 13-4. Estimated Projected Annual Budget for the Next Five-Year Permit Cycle

Monitoring Program Elements	Annual Estimated Projected Costs				
	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Mass Emission Program	$70,000	$70,000	$70,000	$70,000	$70,000
Expanded Tributary Program	$350,000	$350,000	$350,000	$350,000	$350,000
Shoreline Monitoring	Performed by the City of Los Angeles				
Bioassessment	$50,000	$50,000	$50,000	$50,000	$50,000
Future Special Studies	$400,000	$400,000	$400,000	$400,000	$400,000
Bight '08	$600,000*				
TOTALS	$990,000	$990,000	$990,000	$990,000	$990,000

* Lump sum for the cycle of the permit